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ABSTRACT

Energy education units (consisting of a general teacher's guide and nine units containing a wide variety of energy lessons, resources, learning aids, and bibliography) were developed for the Indiana Energy Education Program from existing energy education materials. The units were designed to serve as an entire curriculum, resource document, supplementary materials, or as a laboratory manual of "hands-on" activities which could be infused into existing grades 9-12 curricula. Unit IV, focusing on energy and economics (residential and agricultural), consists of an introduction (rationale, unit objectives, and general background information), seven lessons, unit resources, bibliography, and teacher evaluation form. Each lesson includes lesson title, objectives, background information, activities, evaluation techniques, and resources. Titles of lessons are: (1) Community Involvement in Government Rationing, Pollution - A Role Playing Lesson, (2) Wise Use of Decreasing Natural Resources; (3) Standard of Living; (4) The Need for Energy Conservation in the Home and on the Farm; (5) The Need for Energy Conservation, Student Information Sheets; (6) Resources and Their Wastes - Air, Water and Soil Pollution; and (7) Fuel Consumption Checklist and E.Q. (Energy Quotient) Lesson. (Author/JN)

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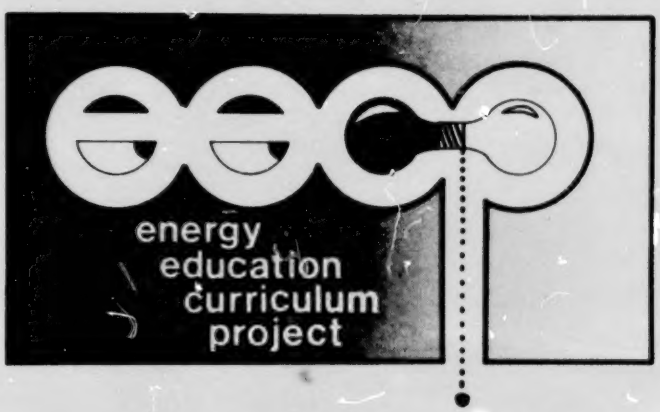
LESSONS from An Energy Curriculum for the Senior High Grades

Unit IV -- Energy and Economics (Residential and Agricultural)



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LESSONS FROM AN ENERGY CURRICULUM

FOR THE SENIOR HIGH GRADES

Unit IV -- Energy and Economics
(Residential and Agricultural)

Division of Energy Policy
Indiana Department of Commerce
Lt. Governor John M. Mutz, Director

Division of Curriculum
Indiana Department of Public Instruction
Harold H. Negley, Superintendent

January 1982

FOREWORD

Indiana educators have always responded to the demands placed upon them by society to resolve natural and human resource issues and problems. The task of teaching energy concepts and conservation practices to Indiana's youth is a response to energy problems facing our state and nation. It will be accomplished by many high school teachers and students getting involved in energy education.

We feel that students of all ages must be taught an energy conservation ethic. This ethic will enable each student to use Indiana's and America's energy resources more efficiently and with less waste. To help high school teachers accomplish this major goal, we are pleased to introduce a new Senior High School Energy Education Curriculum. This exciting and innovative program contains energy education activities, programs and resources for you and your students.

We encourage you and your students to get involved in the lessons presented here. We hope you will use these materials as a starting point and go far beyond by involving other classroom teachers, students, resource agencies and citizens in your community. A broad educational effort is needed to help prepare students to deal with this growing issue which affects us all.

Harold H. Negley
State Superintendent of
Public Instruction

John M. Mutz
Lieutenant Governor
State of Indiana

ACKNOWLEDGMENTS

The Energy Education Curriculum Project is coordinated by the Indiana Department of Public Instruction, Division of Curriculum, with the support and assistance of the Indiana Department of Commerce, Division of Energy Policy, Clarence Broadus, Director.

These materials, from the senior high grades segment of the Energy Education Curriculum Project (EECP), were adopted from existing national energy education programs. The materials were selected by the EECP staff with assistance and direction from a Review Panel and the Energy Education Steering Committee.

The materials included in this unit of the senior high segment of the Energy Education Curriculum Project (EECP), were adopted with permission from:

Energy Management Strategies for Colorado Home Economics Teachers, developed by the Colorado State Board of Community Colleges and Occupational Education, by the Public Service Company of Colorado and by Energy and Man's Environment of Portland, Oregon. The logos for the developers of "Energy Management Strategies for Colorado Home Economics Teachers" are listed below:

Public Service Company of Colorado
an investor-owned utility

EME

COLORADO STATE BOARD
COMMUNITY COLLEGES and OCCUPATIONAL EDUCATION

Energy Conservation: In the Home and On the Farm, developed by the Pennsylvania State University, College of Agriculture, Department of Agricultural Education, University Park, Pennsylvania, in cooperation with Agricultural Education Section, Bureau of Vocational Education, Department of Education, Harrisburg, Pennsylvania, and the Pennsylvania Farm Electrification Council, 1980.

George Cannon, Patricia Shutt and Joe Wright, Energy Education Consultants, Division of Curriculum, supervised the design, printing and dissemination of the EECP senior high school materials. Carol Wood, Teacher Associate, Division of Curriculum, assisted with the design, printing and dissemination of the EECP senior high school materials.

Members of the Senior High Energy Education Steering Committee are John A. Harrold, Director, Division of Curriculum; Darrell Morken, Director of the Division of Traffic Safety; Gary Geswein, Vocational Agriculture Consultant; Jerry Colglazier, Science Consultant; Joyce Konzelman, Home Economics Consultant; Jane Lowrie, Social Studies Consultant; Victor Smith, Research and Evaluation Coordinator; and Gregg Steele, Industrial Arts Consultant.

Clarence Broadus and Michael Hennegan, Division of Energy Policy, offered suggestions and comments which helped to improve the materials.

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INTRODUCTION
(Rationale)

ENERGY EDUCATION- WHAT IT IS - Past, Present, Future

Energy education is the attempt to resolve the conflict between our present life style and the energy costs in both dollars and resources to produce and maintain that life style.

Energy education is reality education in that it deals with what exists here and now.

But, energy education is also a study of futuristics. The future that all of us must be willing to live in and accept is the one that we are creating by our daily decisions. We must examine the beliefs that "growth is good" and "bigger is better" and determine the impact these beliefs will have on our future.

The energy education challenge for teachers considering the challenge, ask yourself the following questions:

1. Can you help prepare your students to make wise and careful decisions about our remaining non-renewable energy resources?

2. Can you help prepare them to investigate and make wise decisions about research and development efforts for alternate and renewable resources, recycling programs, more efficient transportation systems, better personal consumption habits, and a personal commitment to efficient energy usage?

3. Can you explain to your classes where energy comes from, the basic sources of energy, how long our non-renewable energy resources will last, and the energy options among which our nation's people must choose if we are to survive?

The three questions above suggest that energy education is a challenge which encompasses all facets of living. Energy education is an opportunity for students to have impact on a long-lived problem, an opportunity for teachers to cooperate in inter-disciplinary teaching, an opportunity to apply traditional content and skills to an important problem situation, and an opportunity for students to participate in personal and social decisions.

WHY STUDY ENERGY?

"One of the best ways to deal with a crisis is to consider it as an opportunity. From this point of view, the energy crisis provides almost endless possibilities for children to learn about themselves. Energy, after all, is what makes all things go. We need to realize that the energy crisis isn't just the newest fad. By studying the energy crisis, students can see where humanity has been, where it is now, and where it might be going. The energy crisis is another chapter in the story of mankind's continuing effort to reshape the world and the inevitable cost of doing that."[1]

To insure proper utilization of energy sources, our society must be educated about alternative lifestyles, energy resources, technology, consumer behavior and occupations.

The Indiana Department of Public Instruction, in cooperation with the Department of Commerce, Division of Energy Policy, has organized the Energy Education Curriculum Project (EECP) to meet the challenge of educating young people (our future adults) about energy, the energy crisis and the role they can play to help conserve America's economy and resources.

One way the Energy Education Curriculum Project has dealt with the task of disseminating energy information and education is through the Indiana Energy Curriculum Units. The units have been organized to help provide educators in many areas with lessons, charts, materials and "hands-on" activities to be used in the classroom.

[1] Kuhn, David J., "Teaching the Energy Lesson," in the Science Teacher, September 1978.

The Curriculum - Background Information

The Energy Education Units were adopted from existing national energy education materials. A team of teachers reviewed and evaluated energy documents and programs from across the nation, and only those activities or lessons which proved to be effective in educating students about energy were chosen.

The units are designed to be used as the individual teacher wishes. The energy units could be used as the entire curriculum or as a resource document, supplement or laboratory manual of "hands-on" activities which can be infused into already existing curricula.

The Indiana Energy education material for grades 9-12 consists of a Teacher Guide, nine units containing a wide variety of energy lessons, resources, learning aids and a bibliography.

Unit IV

Unit IV entitled "Energy and Economics" (Residential and Agricultural) is composed of seven lessons dealing with energy consumption, conservation and the costs involved. Methods of decreasing energy costs by altering life styles and habits of consumption are discussed. A variety of activities are provided to encourage student participation and understanding.

Unit Objective

1. The student will understand costs of maintaining a particular standard of living.
2. The student will learn that energy used can be wisely controlled.
3. The student will be able to analyze the importance of managing time, energy, economic and environmental resources.

The energy consumption issue covers not only energy per se but also environmental resources, managing time and economics! In reducing personal or household energy consumption man must consider the relationship between his standard of living and energy use, his environmental resources and effects on his environment, his management of time and the cost of doing all these things.

This unit has been designed to aid students in becoming more aware of the energy choices they must make for the present and the future. The costs of maintaining a specified standard of living and the energy used can be controlled with wise choices and major decisions about how man is going to live. This unit can aid the student in making those choices.

UNIT IV

Lessons A-G

Note: The lessons that follow may be infused into an already existing curriculum. It is hoped that the teacher will incorporate those activities which relate to the course of study in the most beneficial manner.

LESSON TITLE: "Community Involvement in Government Rationing, Pollution - A Role Playing Lesson"

LESSON OBJECTIVE

Student will deal with transportation and energy and make recommendations to a mock town council on how to handle the situation, by participating in a role play activity as a community Energy Advisory Board.

BACKGROUND INFORMATION

Background information about the energy problem as it affects transportation - gas, cost, pollution control. Information from community members who fit the roles identified in this exercise. This can be obtained by interviewing people in the community. Furthermore, see the attached section entitled Student Material for More Background Information.

ACTIVITIES

Acquaint students with the roles they are going to play and give them time to become familiar with those roles.

A. This is a role playing exercise where members of the Community Energy Advisory Board are considering the best means of managing the community's transportation service in light of the energy crisis. The questions to be considered include:

   a. Should the present system be maintained (private cars, limited public transportation)?

   b. Should gas rationing be instituted?

   c. Should additional public transporation be provided?

B. Discuss the characters in the play:

   a. Rikki Sever - Head of the CEA Board

   b. Florence Wheeler - A local bicycle shop owner

   c. Busby Tour - Runs the local school transportation system

   d. Anthony Tanke - A service station owner

e. Nancy Raider - Consumer education

f. Burt Conners - Joined the committee to meet Nancy Raider

Other members of the class may take on the job of interested community members attending the meeting and evaluate the cooperation and commitment to solving the problem among committee members.
Time: 2 days

Extension:

Include an assignment to attend a town council meeting or a similar meeting where growth and energy usage are likely to be discussed.

Each student in the role playing exercise may want to make a poster to further support his/her position.

EVALUATION TECHNIQUES

By using the group process observation report included in the packet, students will evaluate the cooperation and commitment of the board members. Students will also be asked to describe the particular interest each board member is promoting.

Students will have their choice of doing either a written or oral report based on what they learn at the town council or energy-related meeting.

RESOURCES

J.C. Penney Co., Consumer Affairs Department, "Energy Issues and Action" Packet, 1978.

"The Energy Mess." Time, July 1979.

Local newspaper articles on mass transit systems in major cities in your area.

Student Material

COMMITTEE MEETING PROBLEM SHEET

COMMUNITY ENERGY ADVISORY BOARD

You are a member of the Community Energy Advisory Board. In light of the President's call for the passage of a comprehensive national energy program, a keystone of which will be conservation, CEAB was established by the Town Council. The Board is cognizant of the differing perspectives on the President's energy program across the country held by:

- economists who are concerned about the relationship of government conservation measures and economic growth;
- business executives who are concerned about the effect of such a policy upon their freedom to make decisions based upon market signals;
- environmentalists who are concerned with the utilization of fuels which may affect environmental standards by degrading air quality;
- consumers who envision lifestyle changes as fuel bills increase and transportation patterns are affected.

The CEAB was authorized to make specific recommendations for dealing with the energy crisis as it impacts on the community. There are no organized consumer interest groups to focus on the energy issue in your area. The Community Energy Advisory Board will be dealing with the topic of transportation and energy (energy usage) at this meeting and has been asked to have specific suggestions prepared for presentation at the next Town Council meeting.

The Town Council has advised your board to consider the best means of managing the community's transportation system in light of the energy crisis.

1. Should the present system be maintained (emphasis on private cars, limited public transporation)?
2. Should gas rationing be instituted?
3. Should additional public transportation be provided?

Heading the CEA Board is Rikki Sever who will report the recommendations to the Town Council.

The members of the CEA Board in addition to Rikki Sever include Florence Wheeler, Busby Tour, Nancy Raider, Anthony Tanke, and Burt Conners.

Background Information

Student Material

Committee Meeting Instruction for Playing a Role

Burt Conners

Please note that the roles have been purposely stereotyped to make a point. These descriptions should not be construed negatively, as that was not the intent!

1. Do not disclose your role description by saying what you do for a living, etc.
2. Read your description carefully and play the role conscientiously.
3. Put yourself into the role that you are given, but do not overact.
4. Be natural, but emphasize behavior aimed at fulfilling your role.
5. The description below represents a somewhat general perspective on the issue. Please add any points which you feel are pertinent and timely to the role you are playing.

You are not really concerned with the work of the Community Action Board. You joined for only one reason, to meet Nancy Raider and eventually ask her out. During the meeting you plan to agree with, and support every point that Nancy makes. Your behavior is guided by your desire to impress Nancy Raider.

Committee Meeting Instruction for Playing a Role

Rikki Sever

Please note that the roles have been purposely stereotyped to make a point. These descriptions should not be construed negatively, as that was not the intent!

1. Do not disclose your role description by saying what you do for a living, etc.
2. Read your description carefully and play the role conscientiously.
3. Put yourself into the role that you are given, but do not overact.
4. Be natural, but emphasize behavior aimed at fulfilling your role.
5. The description below represents a somewhat general perspective on the issue. Please add any points which you feel are pertinent and timely to the role you are playing.

Your role is to conduct the meeting and insure that everyone has a chance to present his/her perspective on the energy/transportation issue. Your group will have 15 minutes for this activity. It will not be necessary for the group to reach a decision.

Personally, you do not believe that there is an energy crisis. You've heard the story about shortages and oil crises before. In addition you've made heavy investments in an energy-intensive way of life. Public transportation in this town is limited and you've got a "gas-guzzler" in addition. Any gas-guzzler tax might penalize a large family that simply needed a bigger car for comfortable transportation.

Committee Meeting Instruction for Playing a Role

Nancy Raider

Please note that the roles have been purposely stereotyped to make a point. These descriptions should not be construed negatively, as that was not the intent!

1. Do not disclose your role description by saying what you do for a living, etc.
2. Read your description carefully and play the role conscientiously.
3. Put yourself into the role that you are given, but do not overact.
4. Be natural, but emphasize behavior aimed at fulfilling your role.
5. The description below represents a somewhat general perspective on the issue. Please add any points which you feel are pertinent and timely to the role you are playing.

You are a consumer educator, active in community affairs and concerned about consumer issues. Since there are no consumer groups in your community, you feel that your participation on the CEA Board will call attention to the need for a permanent Consumer Advisory Board to the Town Council and you would like to become appointed to the Board. You contend that waste has been built into the values of an ever expanding American economy. In the past, technology provided answers but there may be no wondrous new energy source when the old form runs out.

Committee Meeting Instruction for Playing a Role

Anthony Tanke

Please note that the roles have been purposely stereotyped to make a point. These descriptions should not be construed negatively, as that was not the intent!

1. Do not disclose your role description by saying what you do for a living, etc.
2. Read your description carefully and play the role conscientiously.
3. Put yourself into the role that you are given, but do not overact.
4. Be natural, but emphasize behavior aimed at fulfilling your role.
5. The description below represents a somewhat general perspective on the issue. Please add any points which you feel are pertinent and timely to the role you are playing.

You own a gas station and are an active community leader. You are in favor of maintaining the status quo as much as possible since you are concerned about your economic future should any changes be imposed. You are opposed to the gas tax since it is a direct tax on the consumer at the gas pump. Besides, the Administration had proposed a tax on crude oil that was expected to increase gasoline prices by 5-7 cents/gallon.

You feel that many Americans cannot or will not alter their car driving habits as the cost of gasoline alone will not reduce consumption.

Committee Meeting Instruction for Playing a Role

Busby Tour

Please note that the roles have been purposely stereotyped to make a point. These descriptions should not be construed negatively, as that was not the intent!

1. Do not disclose your role description by saying what you do for a living, etc.
2. Read your description carefully and play the role conscientiously.
3. Put yourself into the role that you are given, but do not overact.
4. Be natural, but emphasize behavior aimed at fulfilling your role.
5. The description below represents a somewhat general perspective on the issue. Please add any points which you feel are pertinent and timely to the role you are playing.

You run the local school transportation service. If you can encourage the CEA Board to recommend additional public transportation, you might have the opportunity to gain the franchise since you have the demonstrated expertise in the field. As for car-pooling, you intend to argue, is a hit and miss proposition. You might also point out that, although the President's energy message omitted reference to developing mass transit as a means of saving fuel per se, he did say that "this is a separate item that will be handled under the Transportation Department."

Committee Meeting Instruction for Playing a Role

Florence Wheeler

Please note that the roles have been purposely stereotyped to make a point. These descriptions should not be construed negatively, as that was not the intent!

1. Do not disclose your role description by saying what you do for a living, etc.
2. Read your description carefully and play the role conscientiously.
3. Put yourself into the role that you are given, but do not overact.
4. Be natural, but emphasize behavior aimed at fulfilling your role.
5. The description below represents a somewhat general perspective on the issue. Please add any points which you feel are pertinent and timely to the role you are playing.

You are the mother of teen-age children. You are a partner in a local bicycle shop. Everyone in your family rides a bike and you think that bike riding is both healthy and ecologically sound. Although gas rationing was not mandated in the President's Energy Program, it is a "viable alternative" and could be imposed without Congressional approval if the President declared a national emergency. If gas rationing were to be instituted, your business would probably pick up.

(Extra Activities)

Group Process Observation Report

As a group process observer at the meeting of the Community Energy Advisory Board please answer the following questions. Be prepared to summarize your responses to each question when you report back to the group.

1. How much cooperation did you observe among the Community Energy Advisory Board members?

   Place an X on the line closest to the side (or somewhere in between) which best describes the intensity of your feelings.

   Low degree of Cooperation _____ High degree of Cooperation

2. How committed were each of the members to a common goal? Place an X on the line closest to the side (or somewhere in between) which best describes the intensity of your feelings.

   Low degree of Commitment Rikki Sever High degree of Commitment

   Low degree of Commitment Florence Wheeler High degree of Commitment

   Low degree of Commitment Busby Tour High degree of Commitment

   Low degree of Commitment Nancy Raider High degree of Commitment

   Low degree of Commitment Anthony Tanke High degree of Commitment

   Low degree of Commitment Burt Conners High degree of Commitment

3. Did you think that any of the individuals below had a particular interest to promote? If so, what was that interest?

   a. Rikki Sever _____
   b. Florence Wheeler _____
   c. Busby Tour _____
   d. Nancy Raider _____
   e. Anthony Tanke _____
   f. Burt Conners _____

LESSON TITLE: "Wise Use of Decreasing Natural Resources"

LESSON OBJECTIVE

The student will be able to explain how to read utility meters and apply the methods used in meter reading to actual energy consumption in household appliances.

BACKGROUND INFORMATION/ACTIVITIES

The following material provides student assignments for the teacher to utilize in the classroom to provide hands-on experience in meter reading. By reading utility meters students will observe the effects of wise and unwise uses of energy.

RESOURCES

Contact your local utility company.

"How to Understand Your Utility Bill," U.S. Department of Energy, Technical Information Center, Office of Public Affairs, Washington, D.C. 20585.

"The Home Energy Guide," J. Rothchild and F. Tenney, paperback published by Ballentine Books, 1978, New York.

"Energy Management Checklist for the Home," G. Pifer, U.S. Department of Agriculture, U.S. Government Printing Office, Washington, D.C.

"Energy Facts," Michigan State University Cooperative Extension Service, Lansing, Michigan 48824.

"Energy Related Fact Sheets," Service In Action Series, Colorado State University Extension Service, Fort Collins, Colorado 80523.

"Energy Facts - Save Energy - Save Dollars," University of Maine Cooperative Extension Service, Orono, Maine.

"Selected Department of Energy Publications," U.S. Department of Energy, Technical Information Center, Office of Public Affairs, Washington, D.C. 20585.

Assignment
Teacher Material

1. "Meter Readers All," adapted from Energy & Man's Environment.

   A. Discuss the need for energy by people at home.
   B. Hand out sample meter reading worksheets.
   C. Have students read and record their home electricity meters for a period of time. Have students calculate the kilowatt hours and cost.

2. Do above assignment, plus the following:

   A. Read your meters at home for seven days. Record your readings each day. Calculate the daily energy consumption. Which days require more energy? Why? Are weekends or weekdays more expensive?

3. List ways you can reduce your energy consumption by energy trade-offs, sharing, eliminating use of some appliances, etc.

4. Calculate the cost of your electric bill daily for seven days, according to local utility company rates.

   Time: Class time 2-3 days. Assignment will take 7 total days to complete.

---

5. Have students make a list of electrical appliances in their home.

6. Beside each item on their list, have students write the estimated annual kilowatt hour (KWH) consumption for that appliance. (Contact your local utility company for an appliance consumption chart.)

7. Add these figures to give the total KWH consumption for each family.

8. Divide this total by the number of persons in each family to arrive at a per capita annual KWH consumption.

9. Have a class discussion about which home appliances could be used less or discarded in order to reduce electrical consumption.

10. How would a reduction in use of appliances have an impact on your family?

11. Give a step-by-step description of how the decision-making process could be applied to the reduction in usage of electrical appliances.

Time: Three 45-minute class periods

---

12. Divide class into groups.

13. Have half the group make a collage demonstrating high energy products common in the home.

14. Have the other half make collages of energy efficient appliances.

15. Allow each group to explain their collage to the class. Discuss the pros and cons of using the different products.

Time: Two class periods - 45 minutes long

---

16. Through class discussion, have the students devise a survey sheet for household energy consumption.

17. Interview people as to their awareness of energy consumption and the amount they actually spend on energy.

18. Find out how many people use high energy products which could be eliminated or reduced.

Time: 2-3 class periods - 45 minutes long

EVALUATION TECHNIQUES

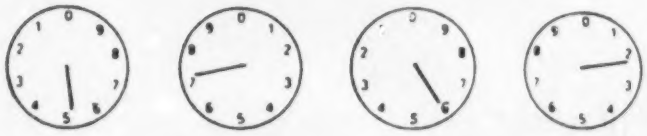
1. Have students accurately read a gas and an electric meter. Students should be able to determine total energy consumption by subtracting their reading from a given meter reading.

2. Through oral discussion, have student explain different appliances which are energy efficient compared to appliances which are higher consumers of energy. How important are the appliances which require higher energy levels to the family members?

3. Have students orally discuss the idea of trade-offs for appliances. (Clothes line instead of dryer, cut down time on television or stereo, eating cold food for meals rather than using appliances for heating are only a few examples which could be discussed.) What impact does trade-off have on the family? How important is it in relation to energy conservation?

Assignment
Student Material

How To Read Your Gas Meter



(thousands) (hundreds) (tens) (ones)

Meter Reading = 5,762 units of gas

Sunday meter reading is 5,762

Next Sunday meter reading is 5,820

How much has home consumed?

5,820
5,762
58 units of gas

(Each "unit" = 100 cubic feet of gas)

Therefore:

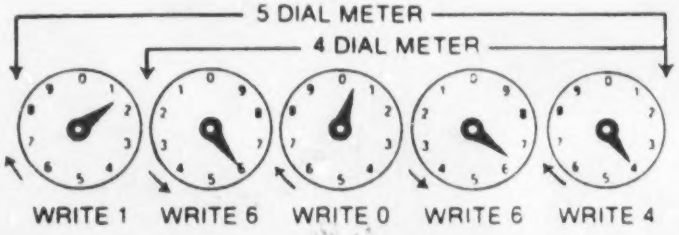
58 x 100 = 5,800 cubic feet of gas used.

To read a meter, record the numbers shown on each dial face, according to their place value. If a meter hand falls between two numbers, use the lower number.

Assignment
Student Material

How To Read Your Electric Meter

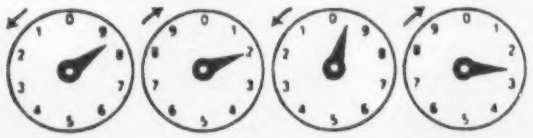
The dials are like watch faces lined in a row (every other dial moves counter-clockwise). The reading for a five dial meter would be 16,064. The reading for a four dial meter would be 6,064.



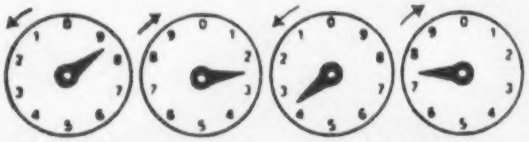
Notice that when the pointer is between two numbers, you should record the lower of the two numbers. When the pointer seems to be directly on a number, look at the dial to the right; if the pointer on the right side dial has passed "0", then write down the number the pointer seems to be on; if the pointer on the right side dial has not passed "0", then write down the previous lower number on the dial you are recording.

Record the Readings for the Following Meters

METER NO. 1

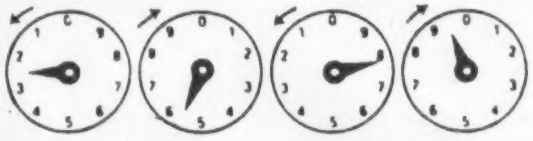


A _____



B _____

METER NO. 2



A _____

B _____

Subtract the number of line A from the number on line B to find the number of KWH of electricity used.

Line B _____ Line B _____

Line A _____ Line A _____

KWH Used _____ KWH Used _____

NAME _____

LESSON TITLE: "Standard of Living"

LESSON OBJECTIVE

The student will illustrate the relationship between standard of living and energy use, by participating in a values classification exercise.

BACKGROUND INFORMATION - See Attached

ACTIVITIES

Discuss the dependence of the American way of life on energy sources.

Use the bulletin board "If We Don't Wise Up - It Will Be 'Lights Out' for a Lifetime" as a discussion guide. An illustration of the bulletin board idea is included on page 23.

Cite the technological advances, dependent on energy, which have influenced the quality of life and lifestyles of the American consumer.

Have the students interview persons over age sixty-five to find out what appliances, utilities and equipment taken for granted in today's home were first introduced during their lifetimes. Ask them to describe the changes these technological advances have made in their patterns of living.

EVALUATION TECHNIQUES

Students will be able to list ways they can conserve energy in leisure time activities following completion of this decision-making activity.

RESOURCES

Energy and Conservation Education: Activities for the Classroom, Grades 10-12, "Uses", Activity #12, Energy & Man's Environment.

BACKGROUND INFORMATION

Assignment

Leisure-Time Activities

1. Make a list of five leisure time activities you enjoy doing.

   Rank in order each activity from the most important to the least important.

   Next to each item, place a $ if the activity costs money each time it is performed.

   For each item assign a mechanical energy point value. Give the activity a 3 if it requires a major amount of mechanical energy consumption, a 2 if a moderate amount of energy consumption and a 0 if it doesn't require any artificial energy sources at all.

   For each item give 3 points for performing the activity a lot, 2 points if the activity is performed occasionally, and 1 point if performed seldom.

   Total the points for each row. Which activities use the most energy?

2. Assume that a severe energy crisis now exists and that all people must conserve as much energy as possible. Cut back your leisure time activities at least 50%.

Class discussion for follow-up:

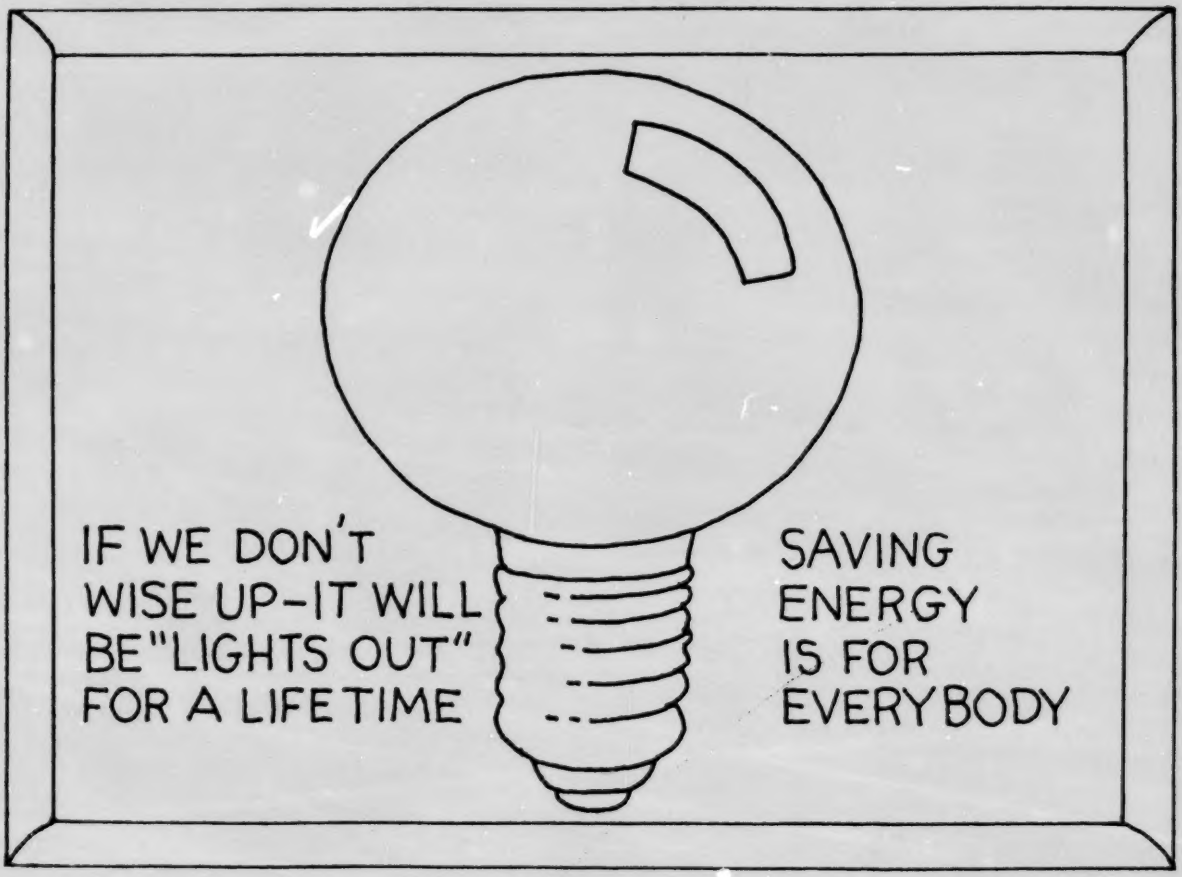
Would you be willing to reduce by 50%? Why or why not?

How did you conserve energy? Which items did you reduce? Prioritize your list.

Does your priority ranking affect your decisions? If so, how?

Does the $ value have any effect on energy usage?

What types of activities can we do that are fun and do not require much use of artificial energy sources?



Objectives:

1. Build awareness of the importance of individual energy conservation
2. Encourage students to use energy wisely

Appropriate Programs:

General Homemaking or Family Living
Household Equipment
Home Management
Consumer Education

Preparation:

Cut out a silhouette of a light bulb from black or deep gray construction paper. Use a felt-tip marker to draw the lines on the bottom of the bulb and letter the bulletin board as illustrated.

Learning Activities:

1. Survey the students. How many of them are using energy-saving methods to reduce the use of electricity, gas or other forms of energy? Make a list of these energy conservation habits.

2. Have students do library research to explore the aspects of the energy situation. What federal policies are being discussed? How much responsibility should consumers assume in reducing energy usage? How will the rise in cost of electricity, gas and other forms of energy affect consumers and industry?
3. Encourage the students to plan a school or community-wide campaign to encourage energy efficiency. Make a list of the community efforts which are already in effect to reduce energy demand.

Reprinted from The Book of Classroom Games and Bulletin Board Ideas, by Mary Anne Symons Brown, Scholastic Magazines, Inc., copyright 1978.

LESSON TITLE: "The Need For Energy Conservation in the Home and on the Farm"

LESSON OBJECTIVE

The student will be able to discuss and justify the need for energy conservation using information about current energy supplies, technology, and the current uses of these energy sources.

More Specific Objectives

At the completion of this lesson, the student will also be able to:

1. Identify energy sources used in the home or on the farm.
2. Identify environmental concerns associated with each source of energy.
3. Discuss the impact of insufficient amounts of fossil fuels.
4. Compute the years of supply of fossil fuels.
5. Identify the extent of our dependence on foreign oil imports.
6. Identify energy resources as exhaustible, inexhaustible, renewable, or nonrenewable.
7. Identify and measure energy losses.
8. Identify the three major polluting by-products of energy consumption.
9. Identify the food-related energy uses.
10. List the job titles and location of agencies in the community involved with energy and conservation-related activities.

Suggested teaching time - 3-5 hours

BACKGROUND INFORMATION

The materials, activities and lessons which follow present ideas to the reader concerning energy conservation. Many aspects of energy conservation, both for the home and farm, are discussed, with helpful hints, technological ideas, and innovative methods by which energy conservation could be feasible.

Background Information to Activities that Follow

Too much. Too fast. Too wastefully. Too complacently. That's how energy is being used, and the consumer is just now beginning to pay the price. In a few instances, the consumer has already been forced to reduce consumption due to gasoline shortages, severe weather, blackouts, and a few brownouts, especially in the Northeast. However, the extent to which the consumer is willing and able to save energy, through either mandatory or voluntary measures, is obviously limited.

Too many unfortunate circumstances have occured which almost entirely wiped out any interest in conservation or any belief that there is an energy problem. In several areas, the consumer was asked to conserve and as a result suppliers raised prices because the public was using less. Now that the price has increased substantially, there seems to be plenty of gasoline; thus, the public cannot believe that an energy problem does exist.

Regardless of what seems to be the situation, the United States faces a serious problem, and the longer the nation waits to confront it, the more critical it becomes. Since the 1973 Arab oil embargo, the United States increased its imports from 36 percent to 52 percent in 1977. Imagine what effect an embargo would have on the nation now! The more dependent the United States becomes on Middle East oil, the more it is at the mercy of the Oil Producing Export Countries (OPEC) cartel. If the United States imports over 50 percent of its oil and OPEC prices rise, the country can obviously expect gasoline and other fuel costs to rise.

Why Conserve?

The consumer can conserve energy and save money year after year by using energy more efficiently. Just adding insulation to a poorly insulated home and sealing air leaks can save at least half the annual heating cost. There are many do-it-yourself activities to help the consumer save energy and money. These activities are clearly presented in this manual and students should be encouraged to participate in them.

Energy Usage

Approximately 20 percent of the energy used in the United States is for residential heating and 25 percent for transportation. Thus, the use of energy for transportation and homes accounts for nearly 50 percent of our total national consumption. By reducing

personal energy consumption in these two areas, the consumer can make a very important contribution. Over 75 percent of the energy used in the home goes for space and water heating. Therefore, it will be most advantageous for the consumer to look at these two areas first and determine the best methods to save energy.

Energy Sources

Oil and gasoline are becoming scarcer in the United States, and the nation is relying more heavily on imports. There are ample amounts of coal, but there are many technological problems to be solved before coal can be mined and burned without damaging the environment. Other sources of energy such as nuclear, solar and wind are being used as substitutes, but these are very expensive and limited in capability.

Oil production in the United States has declined even more rapidly since the production peak in 1971, and it will most likely continue to decline for the foreseeable future. With the scarcity of resources in Canada and Venezuela, the Eastern Hemisphere producers and the Arab countries are the only producers of oil that are meeting the consumer's demand. The development of nuclear energy has been slow because of environmental and safety concerns. It seems unlikely that the estimated 10 percent of the nation's energy from nuclear power by 1985 will be possible. Thus, unless the consumer reduces the growing demand for electric power, shortages are likely to be commonplace in a few years. We are in trouble with our current energy supplies, and new developments seem to be many years away.

Attitudes and Incentives

A few years ago, many Americans began working toward a better environment. Part of the success of this movement was due to a gradual change in our attitudes and habits, and new incentives to have clean air and water for ourselves and our children. The same awareness and concern are needed now to help solve the energy problem. We need to acquire an attitude of less waste and more efficient use. The incentives are obvious: to save money and to help solve one of our nation's most pressing problems. Energy cuts across every aspect of our nation's life: jobs, economy, quality of life, and food production. We need to encourage in each other an energy conservation attitude.

More Background Information

Energy terms used in Activity IV:

Anthracite Coal - Hard coal that yields much heat and little smoke when burned.

Bituminous Coal - Soft coal that yields pitch or tar when it burns.

Breeder Reactor - A nuclear reactor that makes more nuclear fuel than it uses, by changing certain atoms that will not split into atoms that will split.

Carboniferous Period - Presently regarded as having occured from 270 million to 350 million years ago.

Embargo - A government prohibition of entry or departure of commercial ships at its ports.

Energy - The capacity for doing work.

Fossil Fuels - Fuels that were formed from plant and animal material that was subjected to a great deal of pressure for a long period of time (millions of years): oil, natural gas, coal.

Fossilized Remains - Plants and animals that died and were preserved in the earth's crust.

Geothermal Energy - Heat energy produced deep within the earth largely by radioactive materials that occur there naturally.

KWH - Kilowatt Hour - 1,000 watts used per hour.

ACTIVITIES

Get Acquainted with Your Energy Use

Most of us dislike keeping records, but it is often a very good way to save money.

1. First, have the students start by keeping a record of their family gasoline use; as they begin to develop ideas to cut down on their usage, it will be easy to calculate how much they save in gasoline and money. They will, for example, be able to see the effect of keeping their automobiles tuned for a maximum performance.

2. Next encourage them to get acquainted with their house, mobile home, or apartment. Determine where heat and cooling losses are occurring. Look in their attic for insulation, and measure how much is there. Once they become familiar with their home and its energy use, they will be able to determine what they can do to save the most energy and money.

3. There is an energy management checklist in the back of this lesson. Check off each thing they do, and they will soon see a big difference in the energy use and comfort in their home.

4. Then, if they have been keeping records, they will see how much money they save. The cost of energy will continue to increase, but with some conservation efforts, the total cost may not go up at all, or possibly may decrease substantially.

More Activities

THE NEED FOR ENERGY CONSERVATION
INFORMATION

I. Teacher Activities:

A. Obtain meter-reading pamphlets.

B. Obtain sample copy of a local electric rate chart.

C. Obtain sample electric bill.

D. Reproduce student information sheets:

1. Test your Energy Quotient (E.Q.)
2. Fuel consumption checklist

II. Student Activities:

A. List sources of energy and environmental and economic concerns related to the production and consumption of energy.

B. List the uses of energy.

C. Compute the years of supply of fossil fuels using a consumption rate of 6.9 gal./day/person x 240,000,000 people = _____.

D. List the job titles and the locations of agencies concerned with energy and conservation of energy.

E. List the major consumers of energy in your area.

F. Invite resource people to discuss the following:

a. Utility rate schedules (all electric rate)
b. Building codes
c. Insurance restrictions
d. Building contractors (energy efficient new homes)

G. Complete the E.Q. test sheet.

H. Complete the fuel consumption checklist.

RESOURCES

Our Energy, Problems and Solutions. Pennsylvania Power and Light Company. Contact Mr. Oscar C. Lange, Chairman, Customer Relations, Phone: 215-821-5151 for classroom copies, or contact the PP&L office.

Managing Energy on the Farm. Agway Incorporated, Attention: Mr. Norman Agor, Manager, Energy Management, Box 4933, Syracuse, NY 13221.

Food and Energy. Food and Energy Council, 909 University Avenue, Columbia, MO 65201. $1.00/each.

Our National Resources. P.E. McNall and Harry B. Kircher, The Interstate Printers and Publishers, Inc., Danville, IL 61832, 1970.

Energy and the Environment: A Citizens Workshop Handbook. ERDA, Superintendent of Documents, United States Government Printing Office, Washington, DC, #640-287/17, 1975.

Local Public Utilities:
a. Sample electric bills
b. Rate schedules
c. Meter-reading pamphlets

The following materials that could be used by the very interested students can be ordered from Penelec (Pennsylvania Electric Company)

- Guideline for the Implementation of the Time-of-Day Rate (focusing on off-peak use).
- The New Residental Load Factor Service Program (focusing on demand reduction)
- The National Energy Watch Score Sheet (focusing on upgrading insulation and construction standards to conserve energy)

The Pennsylvania Energy Primer. An Introduction to Energy for Pennsylvania. The Governor's Energy Council.

LESSON TITLE: "The Need for Energy Conservation, Student Information Sheets"

LESSON OBJECTIVE

The student will be able to discuss the use of alternative energy sources and the advantages and disadvantages of each by reading and studying the information sheets.

BACKGROUND INFORMATION/ACTIVITIES

The following lesson provides important information dealing with energy conservation in an outline format. Many aspects of energy conservation are emphasized in addition to a detailed discussion on alternative energy resources.

Activity 1

A. Discuss with students the need for energy conservation.

1. Trends in the rate of energy consumption in the United States:

a. Annual energy consumption has doubled since 1950.

1. U.S. contains 6% of the world's population.
2. U.S. consumes 1/3 of the world's energy.

b. Sources of energy, mainly gas and oil, are limited.

c. Present energy consumption of gas and oil is approximately 6.9 gallons per person per day.

d. Daily energy use:

(1) Personal

(a) 42% transportation
(b) 40% heating and air conditioning
(c) 6% hot water
(d) 4% cooking
(e) 4% refrigeration
(f) 1% lighting
(g) 3% miscellaneous

(2) Total personal - 37%

(a) 21% - residential
(b) 16% - transportation

(3) Total business and government - 63%

(a) 41% industrial
(b) 14% commercial
(c) 8% transportation

e. Almost half of all the energy individuals consume is for transportation.

f. Home energy consumption:

(1) Space heating and cooling is the greatest single energy user in the home (40%).

(2) Hot-water heater is the second largest consumer of energy in the home.

(3) Energy required to preserve food is third in home energy consumption.

(4) Energy for cooking.

(5) Energy for dishwashers.

(6) Energy for laundering.

(7) Energy for lighting.

(8) Energy for other uses:

Small appliances.
Swimming pools.
Workshop, yard, garden.
Farming.

g. Between now and the year 2000, the United States will consume more energy than it has in its entire history.

h. By the year 2000, the United States demand for energy will more than double; worldwide demand will triple.

i. The average family of four spends between $1,200 and $3,000 directly for energy each year.

j. Before the oil embargo of 1973-74, we were importing 36% of our annual oil requirements.

k. Oil will be one of the first major fuel resources to be exhausted.

1. Energy use related to food accounts for 16% of the total energy consumed in the United States. The breakdown is as follows:

(a) 33% food - Food processing
(b) 30% - Households
(c) 18% - On-farm production
(d) 16% - Wholesale - retail
(e) 3% - Transportation

m. Farm energy consumption:

(1) Presently a farmer feeds 55 other people.

In order to keep pace with the world population growth, the farmer would have to increase crop production by 5.4% per year.

(2) Energy consumption is directly related to the farmer's ability to produce more food.

(3) Major areas of consumption:

(a) Heating farm structures.
(b) Ventilating farm structures.
(c) Lighting farm structures.
(d) Heating water.
(e) Refrigeration.
(f) Related crop demands on energy.
(g) Tractors and trucks.

(4) Increased farm efficiency is necessary to increase farm production in the future.

2. Need for reduced consumption/altered standard of living:

a. In sunny climates it is thermally advantageous to have the ridge of the house parallel to the east-west axis.

b. In cold climates a north-south ridge would be best.

c. In cold climates evergreen trees and hillsides can buffer against cold winds.

d. Multi-family buildings are more energy efficient than single family homes, because there is less total wall area exposed.

e. Reducing the ratio of exterior wall area to floor area will reduce energy demand.

f. Avoid long skinny houses and L-, T-, and H-shaped ones.
g. Thermal-type windows (double or triple glass) reduce heat loss.

3. Need for greater production by the United States:

a. The United States energy problem requires action and commitment from every element of our society.

b. Where do we go from here?

(1) We can utilize the vast resources of coal.
(2) We can utilize our capacity for producing nuclear power.
(3) Revert to hand-labor system of production.
(4) Other energy sources need to be developed for the future: solar, geothermal, tidal, wind, oil substitutes.

c. Power suppliers have an obligation to provide energy to meet the consumer's demand at the lowest possible price.

d. Government must continue to:

(1) Develop and implement comprehensive energy policies and priorities.
(2) Exert leadership in encouraging conservation.
(3) Resolve regulation conflicts.
(4) Keep citizens informed of their responsibilities in conserving energy.
(5) Work with industry in planning energy use.

e. The consumer must:

(1) Conserve present energy resources.
(2) Support and encourage research to develop alternate energy sources.
(3) Cooperate with power suppliers in plant location and transmission line routes.

Activity 2

B. Discuss with students the various energy forms.

1. The Big Four

a. Oil
b. Natural gas
c. Coal
d. Nuclear

2. Others:

a. Water (tides, oceans, rivers)
b. Solar
c. Wind
d. Geothermal
e. Trash (garbage)
f. Deuterium/tritium (nuclear fission)
g. Hydrogen (similar to natural gas)

OIL

3. Three million years ago, during the Carboniferous Period, oil was formed from deposits of plant and animal life. Oil is found in veins above a layer which supported life and was covered with an impervious layer of rock. Oil is stored in porous rock. Limestone, sandstone, and beds of sand are examples. Reserves of oil are estimated to last from 40 to 70 years at the present consumption rate and 20 years if only United States resources are used.

NATURAL GAS

4. During 1973 the nation used approximately 23 trillion cubic feet of gas, 2½ times the amount used 10 years earlier. At this rate the power reserves will last only about 13 years.

COAL

5. Coal is formed from fossilized remains of trees and heavy vegetation that lived millions of years ago. It takes 1,000 years to form a 1-foot layer of coal. Types: Peat, lignite, bituminous, and anthracite. Pollution arising from burning coal is still a major economic and environmental problem. There is a 250-to 300-year supply of coal in the United States.

NUCLEAR ENERGY

6. Nuclear Energy

a. Atomic energy from nuclear fission (splitting atoms apart)

(1) About 20,000 times as much heat and energy is released from uranium fuels as from an equivalent amount of coal.

(2) Question of safety due to long-lasting radioactivity of atomic wastes.

(3) Breeder reactors - energy out-put could be 1,500,000 to 1 when compared to coal.

b. Nuclear fusion (fusing together)

(1) Unlimited energy supply.

(2) Process is difficult to control.

(3) Requires extreme pressure and temperatures as high as 100 million degrees.

(4) Fueled from deuterium, available in almost unlimited supply from sea water.

SOLAR ENERGY

7. If solar energy is converted to usable power, solar radiation alone would meet all our energy needs.

a. Large expense in the installation of heat collectors.

b. By 1985 sales of photovoltaic arrays alone could exceed 400 million dollars.

GEOTHERMAL ENERGY

8. Power from heated rocks or molten magma in the interior of the earth is usually transferred to the surface as heated water/steam.

a. It is estimated that the heat in the top 10 miles of the earth's crust is equivalent to 2,000 times the amount of heat potential from the earth's total resources of coal, but much of this energy is impossible to reach.

b. The Department of Interior forecasts that 20% of the nation's electric power by 1985 will be geothermal.

WIND AND WATER POWER

9. Wind and Water Power

a. Wind power - disappearance of windmills was due to better and more efficient power sources and no control of winds.

(1) Slow and not a reliable source of energy.
(2) Requires storage of electric energy for future use or when there is no wind.

(3) Wind responsible for rainfall.

b. Water power

(1) Cost of installation is high.
(2) Operation costs are high.
(3) Irregular water supply.
(4) Dams fill with sediment.
(5) Agricultural land must be flooded - damage to the environment.
(6) Even if all streams were harnessed, the present energy output of 1% would at best double (2%).

c. Tidal power - Bay of Fundy - 18 foot tides - 7½ miles of dams would trap 70 billion cubic feet of H2O and generate 1,000,000 KW of power.

d. Heat interchanges in the sea.

e. Gulf Stream currents.

WASTES, TRASH, AND SEWAGE SLUDGE

10. All can be used to supplement fossil fuel. This will reduce environment problems, conserve scarce fuel, conserve land, etc.

HYDROGEN

11. Hydrogen

a. Made from H_2O.

b. Burned as a gas.

c. Inexhaustible supply of energy from the seas.

Activity 3

C. Discuss with students present energy uses.

1. Determine exhaustible, inexhaustible, renewable, and nonrenewable resources.

2. Energy use table, page 29 of Our Natural Resources, 1970: Coal, 23%; Oil, 43%; Gas, 33%; Water, 1%; Nuclear, 1%.

3. Predicted energy use rise from 1980 to 2000:

Total energy use	+ 90%
Petroleum (oil)	+ 51%
Gas	+ 58%
Coal	+ 11%
Nuclear energy	+ 1000%

4. Energy - 40% Industries; 25% Transportation; 33% Commercial and Residential Buildings.

Activity 4

D. Discuss with students environmental concerns - One of the most serious hurdles to the use of energy reserves has been the concern for the potential effect on the environment. Everyone wants to protect the land, water, and air. How can this be done and still develop the most economic sources of energy? Some compromises or reasonable tradeoffs will have to be made. But what compromises should be made?

Resources

Energy Use and Utilities - Consumer Decisions, A Handbook of Consumer Education, Boyd/Stovall, Allyn & Bacon, Inc., 1978, p. 83-88.

How to Conserve Energy at Home, L. Channing Bete Co., 1975, Greenfield, Massachusetts.

Save Energy: Save Money, Eccli, Eugen and Eccli, Office of Economic Opportunity, Washington, D.C. 20505, 1975.

Tips for Energy Savers: In and Around the Home, On the Road, In the Marketplace, Federal Energy Administration, Washington, D.C., 20461.

"Conserving Energy by Changing Societal Goals," Illinois Teacher, September/October 1976.

The Homeowner's Survival Kit, Watkins, Hawthorne Books, 1971.

"Alternative Energy Sources," American Petroleum Institute, Attn: Information Service Department, 2101 L. Street, N.W., Washington, D.C. 20037. Phone: (202) 457-7000.

"Synergy - Working Together for Energy Tomorrow," North Carolina State University, Agricultural Extension Service, Raleigh, North Carolina 1978.

"Energy Conservation and Environment," U.S. Department of Energy, Technical Information Center, Office of Public Affairs, Washington, C.D. 20585.

"Energy Conservation Now," Consumer Information Center, Pueblo, Colorado, 81009.

"Energy Conservation and the Rural Home," U.S. Department of Agriculture, Office of Governmental and Public Affairs, Washington, D.C. 20250.

FILM:

"Energy: The Facts - The Fears - The Future," produced by CBS News 1977. Russ Bensley and Ernest Lieser.

LESSON TITLE: "Resources and Their Wastes - Air, Water and Soil Pollution"

LESSON OBJECTIVE

The student will be able to discuss the possible environmental consequences of various fossil and alternate energy sources.

BACKGROUND INFORMATION

Resources and Their Wastes

AIR, WATER, AND SOIL POLLUTION

A simple law of physics states: "Energy cannot be created or destroyed," but energy can be converted into other forms. When you burn a gallon of gasoline in your auto you convert the energy contained in that gasoline to heat, smoke, ash, and gases. Only a small percentage of that heat is used to drive the car. The excess or unused heat is lost through the cooling system or the tail pipe. Some of the heat energy used to drive the pistons is lost in overcoming friction within the engine and drive train. Only a fraction of the energy finally reaches the drive wheels to move the car.

The waste products that are produced as energy is consumed are:

1. Heat
2. Smoke and ash
3. Gases

A method of disposing of or using these by-products without harmful effects on our environment must be found.

Not all by-products of energy production are harmful. Recreational facilities are beneficial by-products of hydroelectric power generation facilities. Lakes and reservoirs provide swimming, fishing, and boating, and surrounding areas are developed for camping and hiking.

EXCESS HEAT REMOVAL

The heat which is a by-product of the consumption of energy can frequently be diverted to beneficial uses. During the winter, some of the "waste heat" from your auto engine is diverted to the car's interior. The same principles can be applied to use this waste heat in commercial applications. Some power companies are piping their hot water to heat various structures such as greenhouses and factories.

Discharging hot water directly into a lake or river will raise the temperature of the water enough to make the water unsuitable for the natural species of marine life which inhabit the water. Waters warmed by this heat could be used to increase the production of seafood products. These cooling lakes could be used to help meet the nation's food needs by producing various seafoods which will grow under the warmer conditions.

Where no practical use of waste heat can be developed, cooling towers, which are little more than gigantic chimneys, are used to cool the water before it is discharged into the environment.

SMOKE AND ASH

Coal burning power plants give off smoke and ash. Eletronic devices are used to remove the solids before they are exhausted into the atmosphere. These pollutants can then be handled like any solid waste product and can be disposed of in approved landfill operations where they will not pollute the soil or ground water.

GASES

When burning fossil fuels, gases such as sulfur dioxide (SO_2) are produced. Very tall stacks (usually 1,000 feet tall) are used to dissipate the gases high into the atmosphere. Special devices (collection scrubbers) are being developed to remove the sulfur usually found in exhaust gases of fossil fuels.

NUCLEAR ENERGY

Everyone is aware of the tremendous power contained in the atom as seen in photographs of the explosion of an atom (or nuclear) bomb. Because of this, the atom is often associated with destructive potential. One pound of nuclear material will produce as much heat as 1,500 tons of coal. Uranium contains three million times the heat energy contained in an equal weight of coal.

Safety

Commercial nuclear power plants have already accumulated over 300 reactor years of operating experience with no accidents causing death or injury to the public. This is the best safety record of any American industry. A nuclear reactor cannot explode because its fuel contains only 3% U-235.

The chances of an individual who lives in the area of a nuclear power plant being injured in an explosion are only 1 in 75 million. However, the transportation, storage, and disposal of radioactive materials is one of the gravest social responsibilities mankind has ever assumed.

Breeder Reactors

The development of breeder reactors can provide an inexhaustible supply of energy. This special type of reactor produces nuclear fuel rather than consumes it.

Economic and Conservation Concerns

1. Fossil fuel supply is limited.

   Gas - Reserves are available in the United States to meet present demands for only one decade. Much of the nitrogen fertilizer used by farmers is manufactured from natural gas.

   As the supply decreases, shortages of fertilizer needed for food production will occur. Substitutes must be developed to make United States gas reserves last as long as possible.

   Oil - A 30-to 40-year supply of oil is available at the present rate of consumption. Domestic reserves are decreasing as consumption is increasing at a rate of 4.8% per year.

   Coal - A 200- to 800-year supply (390 billion tons of coal) exists and it has the greatest potential as fuel to power our generating plants. It is our most abundant fossil fuel resource. However, there are problems with removing the pollutants from coal to make it a cleaner fuel. New equipment must be developed to solve this problem.

2. United States dependence on foreign oil:

   1970 - 24% of the oil used in the United States was imported (3.4 million barrels per day).

   1977 - 52% of the oil used in the United States was imported (8.6 million barrels per day).

   1985 - As our domestic production decreases and our consumption increases, we will need to import additional foreign oil. Foreign oil is increasing in price each year.

3. Energy and our economy

   All goods and services from our economy depend directly or indirectly on useful energy.

   As energy supplies decrease, costs will increase

and the cost of living will go up. This will reduce the demand for goods and services causing job layoffs. In the end we will have both inflation and unemployment. We have already seen this happen to a slight degree in 1974 with the oil embargo.

Energy waste must be eliminated to keep a healthy economy and maintain our standard of living.

ACTIVITIES

E. Activities in Conservation

Proper conservation measures can extend our supply of fossil fuel.

The following material provides information dealing with ways energy may be conserved. Students might want to become involved by participating in the activities, followed by a report of their actions and the results. For example, outside the home, a student might want to form a car pool and then calculate how much petroleum and money were saved over a set period of time. Also students might want to keep a record of what types of public transportation are provided and the number of people utilizing that service.

Inside the home, students could calculate the energy & money saved by turning down the heat in the winter and using a higher temperature for the air conditioner in the summer. These are just a few activities that might be easily infused into the classroom curriculum.

Therefore, by doing some of the conservation activities, it is hoped that the student will observe that proper conservation measures will extend our supply of fossil fuels.

1. Gasoline can be saved by using:

   a. Public transportation
   b. Car pools
   c. Reasonable speeds when driving
   d. A minimum number of trips
   e. A well-tuned car that is small and efficient

2. Energy can be saved in the home by:

   a. Installing weather stripping on doors and windows
   b. Adding storm doors and windows
   c. Cleaning and checking the furnace regularly

d. Turning down the heat in the winter and using a higher temperature for the air conditioner in the summer
e. Repairing leaking faucets
f. Turning off lights when not in use

RESOURCES

Energy saving tips from literature published by:

Public Utilities
Oil Companies
Automobile Manufacturers
Appliance Dealers
Home Builders Groups

LESSON TITLE: "Fuel Consumption Checklist and E.Q. Lesson"

LESSON OBJECTIVE

Students will be able to demonstrate knowledge and understanding of energy and environmental issues by completing the checklist, E.Q. quiz and a Lesson G test.

BACKGROUND INFORMATION

Prior to completing the E.Q. sheet and test (attached) the students should complete the fuel consumption checklist. This should be done through hands-on activities and research to provide the student with information dealing with energy consumption.

Fuel Consumption Checklist

I. Electricity:

A. Read the electric meter _____ (date) _____ (KWH)

B. Read the electric meter 30 days later

_____ (date) _____ (KWH)

C. Total KWH used _____ Total Electric Bill _____

D. Price per KWH: _____

II. Fossil Fuels (oil, coal, gas):

A. How many gallons of fuel used in one week?

1. home furnace	___	7. motor bikes	___
2. auto A	___	8. snowmobiles	___
3. auto B	___	9. lawn equipment	___
4. truck A	___	10. tractor A	___
5. truck B	___	11. tractor B	___
6. other	___	12. other	___

B. Suggestion for calculating fuel consumption:

1. Home furnace - Take two consecutive fuel bills and divide the amount of fuel consumed in that period by the number of weeks between bills. For example:

$$\text{Weekly consumption} = \frac{\text{amount of fuel consumed}}{\text{number of weeks to consume the fuel}}$$

2. Motor vehicles - Fill the fuel tank and then operate the vehicle normally for one week. The amount of fuel needed to refill the tank is the fuel consumption for one week.

ACTIVITIES

Test Your E.Q. - Activity 1

Take this quiz to check your knowledge and understanding of energy-environmental issues.

1. How much of the energy used in gas stoves supplies the pilot lights?

   a. 10%
   b. 25%
   c. 50%

2. An incandescent lamp and a fluorescent lamp having the same light output: Which uses energy more efficiently?

   a. fluorescent
   b. incandescent
   c. both about the same efficiency

3. How many soft drink cans can be manufactured from recycled aluminum with the energy needed to make a single can from aluminum ore?

   a. three
   b. five
   c. twenty

4. How long would a 100-watt light bulb burn on the energy needed to manufacture one throw-away soft drink can or bottle?

   a. 10 minutes
   b. 5 hours
   c. 20 hours

5. How much of the energy stored in crude petroleum is lost between the oil well and a moving car?

   a. 20%
   b. 60%
   c. 90%

6. The heat energy of a gallon of gasoline is equivalent to:

   a. 5 man-days of labor
   b. 15 man-days of labor
   c. 25 man-days of labor

7. How much faster than their rate of production are we consuming our fossil fuels?

   a. 10 times
   b. 1,000 times
   c. 1,000,000 times

8. What fraction of the world's energy consumption occurs in the U.S.?

   a. over 10%
   b. over 20%
   c. over 30%

9. Which of the following fuel resources is in greatest danger of exhaustion?

   a. coal
   b. petroleum
   c. nautral gas

10. By the year 2000, America's energy requirement will be:

    a. the same as today
    b. twice as much as today
    c. three times as much as today
    d. unknown

Answers to the E.Q. Test

Score 1 for each correct answer. 0-5 Poor,6-7 Fair, 8-10 Good.

1. (c) Approximately half of the gas used in a gas stove is used to fuel the pilot light to burn continuously.

2. (a) Fluorescent lights give off three to four times as much light per watt of electricity used as incandescent lamps do. One 40-watt fluorescent light gives more light than three 60-watt incandescent bulbs (and the annual savings may be as much as $10).

3. (c) Aluminum is a very energy intensive material with the largest share of the energy going to process the ore. Recycling is a great energy saver. The nation's total throwaway containers' equivalent energy waste is equal to the output of 10 large nuclear power plants.

4. (b) A 100-watt lamp could burn for five hours on the energy used to manufacture a disposable can or bottle.

5. (c) Ninety-four percent of the energy in the gasoline from crude petroleum is lost in making your car move. The efficiencies of the most important steps where energy is lost are:

producing the crude oil	96%
refining	87%
gasoline transport	97%
engine thermal efficiency	29%
engine mechanical efficiency	71%
rolling efficiency	30%

6. (b) Fifteen man-days of labor. Said in another way, one barrel of oil contains heat energy equivalent to the energy of two man-years of labor.

7. (c) In less than 500 years man will have consumed essentially all of the coal, oil and gas that nature started forming 500,000,000 years ago.

8. (c) More than a third of the world's energy is consumed by the 6% of the world's population residing in the United States.

9. (c) Natural gas reserves in the United States are expected to be exhausted in about 40 years. Petroleum should last for a century. Coal, 500 years or so.

10. (c) For more than a century, American demand for energy has doubled, on the average, every 20 to 25 years.

Activities Continued

Test - Activity 2

Place the letter of the correct answer in the blank provided for each question.

1. Which fossil fuel is in shortest supply? _____

   a. Coal
   b. Gas
   c. Geothermal
   d. Oil

2. Gas is important in the production of food because it is a major supplier of nitrogen fertilizer. _____

   T or F

3. Our economy is directly dependent on useful energy. _____

   T or F

4. What % of the oil used in the United States in 1977 was imported? _____

   a. Less than 20%
   b. 30%
   c. 40%
   d. Over 50%

5. Which fossil fuel has the greatest potential as a fuel to power our generating plants? _____

   a. Coal
   b. Gas
   c. Nuclear
   d. Oil

6. The present oil consumption is approximately _____ gallons per day per person.

   a. 3
   b. 15
   c. 7
   d. 20

7. _____ uses nearly one-half of all the energy consumed in the United States.

   a. Transportation
   b. Processing
   c. Cooking
   d. Heating and air conditioning

8. _____ is the greatest energy user in the home.

a. Hot water heater
b. Cooking
c. Electrical appliance
d. Space heating and cooling

9. _____ will be the first major fuel resource to be exhausted.

a. Natural gas
b. Coal
c. Oil
d. Nuclear energy

10. In order to meet future food needs, the farmer must increase his production by approximately _____ each year.

a. 4%
b. 10%
c. 2%
d. 25%

11. Which of the following is not a major energy source utilized at present? _____

a. Oil
b. Solar
c. Coal
d. Natural gas

12. Usable energy from inside the earth's crust is called _____.

a. Geothermal
b. Geometric
c. Volcanic
d. Geology

13. According to present consumption rates, which of the following uses the most energy? _____

a. Transportation
b. Commercial buildings
c. Homes
d. Industry

14. Solar energy use at present is minimal due to _____.

a. Large range of temperature in the United States
b. High cost of installing heat collectors
c. Lack of manufacturing of solar components
d. No practical application now

15. Which of the following statements about nuclear power is false? _____.

a. There are higher installation costs than conventional power systems.
b. Safety is an important consideration.
c. Shortage of nuclear fuel is a major limiting factor.
d. Increased demand for energy may promote the use of nuclear power.

16. What is the most serious obstacle in the development of new energy sources? _____.

a. Cost of building materials
b. Environmental concerns
c. Lack of technology
d. Public apathy

17. Which of the following is not a by-product of energy consumption? _____.

a. Heat
b. Smoke
c. Oxygen
d. Gases

18. One pound of nuclear fuel used in a breeder reactor can produce as much heat as _____lbs. of coal.

a. 1,500
b. 150
c. 1,500,000
d. 300

19. A type of nuclear reactor which produces more fuel than it consumes is a _____.

a. Fission reactor
b. Generator reactor
c. Cold water reactor
d. Breeder reactor

20. The fuel in a nuclear reactor contains _____% of the explosive material U-235.

a. .1%
b. 10 %
c. 50 %
d. 3 %

RESOURCES

Your local public utility
Appliance and automobile dealers

ANSWERS TO TEST

1. a.
2. T
3. T
4. d.
5. *a. or b.
6. c.
7. *a. or d.
8. d.
9. *c. or a.
10. a.
11. b.
12. a.
13. d.
14. a.
15. a.
16. *c. or b.
17. c.
18. c.
19. d.
20. d.

* preferred answer

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PLEASE TELL US WHAT YOU THINK ABOUT THE SENIOR HIGH SCHOOL ENERGY MATERIALS

Your position: (check)
_____teacher
_____dept. head
_____administrator
_____other

Your grade level: _____

Subject(s) taught: _____

If possible, please answer these questions after you have taught unit lesson(s) in your class and examined teacher's guide. If this is not possible, please answer based on your personal inspection of the unit materials.

1. What project materials are you evaluating? (Check all that apply)

_____Unit I
_____Unit II
_____Unit III
_____Unit IV
_____Unit V
_____Unit VI
_____Unit VII
_____Unit VIII
_____Unit IX
_____Teacher's Guide

2. What is the basis for this evaluation? (Check all that apply)

_____(1) teaching 4 or more lessons
_____(2) teaching 1 to 3 lessons
_____(3) personal inspection
_____(4) discussion with others who know materials

3. Have you shared these units with other educators? (Check one)

_____(1) No
_____(2) Yes, with 1-4 others
_____(3) Yes, with 5-10 others
_____(4) Yes, with more than 10

Circle the number from 1 (Definitely No) to 7 (Definitely Yes) which best reflects your answer.

	DEFINITELY NO			NEUTRAL			DEFINITELY YES
4. Are these materials easy to understand and use?	1	2	3	4	5	6	7
5. Do these materials fit with the curriculum of your district?	1	2	3	4	5	6	7
6. Are you likely to make use of these materials in the future?	1	2	3	4	5	6	7
7. Are these materials appropriate for the level of your students?	1	2	3	4	5	6	7
8. Are these materials interesting to your students?	1	2	3	4	5	6	7
9. Is the reading level appropriate?	1	2	3	4	5	6	7
10. Do you think these materials will reduce energy consumption?	1	2	3	4	5	6	7

What did you like best? _____

What did you like least? _____

Suggestions/Comments (Use the back as needed): _____

RETURN TO: Energy Education Curriculum Project, Division of Curriculum, Department of Public Instruction, Room 229, State House, Indianapolis, IN 46204.